Scanning the Past

John A. Fleming and the Fleming Valve

Sixty-five years ago, the Institute of Radio Engineers (IRE) awarded its Medal of Honor to the British scientist and inventor John A. Fleming (Fig. 1) as recognition for his significant contributions to telecommunications science and engineering. As a well-known pioneer in wireless communication and applied electronics, he enjoyed a long career as a researcher, inventor, and educator. He participated in early long-distance wireless experiments with G. Marconi and was a prolific author of books and technical papers. Fleming is remembered especially for his pioneering experiments with the "Fleming valve" (Fig. 2), a diode vacuum tube that he employed as a detector of wireless signals in the early years of the twentieth century. As an immediate precursor of the vacuum-tube amplifier, the Fleming valve was a strategic innovation in the history of electronics (Fig. 3).

The son of a congregational minister, Fleming was born in Lancaster, England, in 1849. He received a degree in science from University College, London, in 1870, and then was a teacher until 1877, when he enrolled at St. John's College of Cambridge University. He attended lectures by J. C. Maxwell and also did research at the Cavendish Laboratory. Fleming developed a precision resistance bridge instrument given the nickname "Fleming's banjo" and used it to compare resistance standards. He received the doctorate degree in 1879 and continued at Cambridge as a laboratory demonstrator until 1881, when he accepted a teaching position at Nottingham. He did some consulting work for the Edison Electric Company on incandescent lamps. In 1885, he joined the faculty of University College, London, where he spent the rest of his professional career.

One of Fleming's early investigations was concerning the "Edison effect," where he studied the unilateral conductivity of a carbon-filament lamp with a metal plate connected to an external circuit (Fig. 4). In December 1889, he presented a paper on this work to the Royal Society of London entitled "On Electric Discharge Between Electrodes at Different Temperatures in Air and High Vacua." He also conducted extensive research on alternating-current transformers, which led to his publication of a two-volume work, *The Alternate Current Transformer,* in 1889 and 1892. He published a number of joint papers with J. Dewar during the 1890's related to the electric and magnetic properties of materials at low temperatures. Fleming was elected a fellow of the Royal Society of London in 1892.

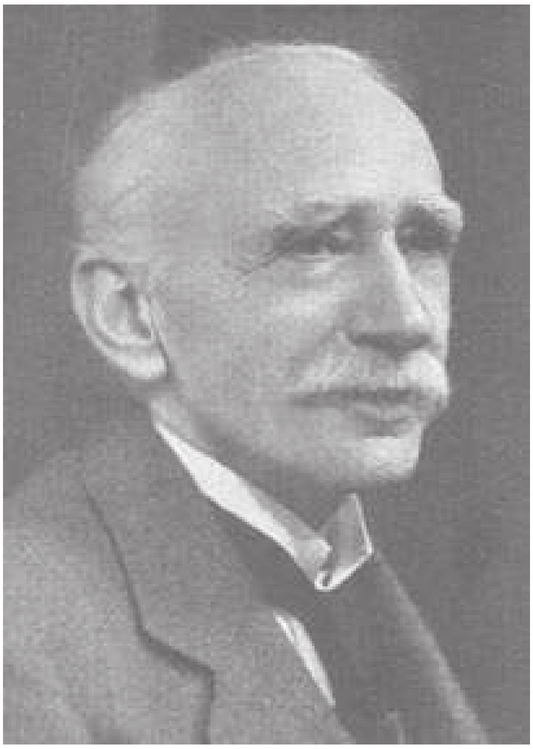

Fig. 1. John Ambrose Fleming.

In April 1898, Fleming was permitted to examine Marconi's wireless apparatus at the time it was being used to send messages for about 14 miles from the Isle of Wight. In late March 1899, Marconi demonstrated communication between England and France across the English Channel, an achievement that Fleming characterized as "one of those sensational feats which at once aroused the daily press to lively comment on the matter." Fleming participated in these experiments and reported the results in a letter published by *The Times* of London. He stated that "messages, signals, congratulations, and jokes were freely exchanged between the operators" situated on opposite sides of the channel. Later the same year, Fleming gave a lecture at a meeting of the British Association for the Advancement of Science in Dover during which wireless messages were

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